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Simpson

INSTRUMENTS THAT STAY ACCURATE

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390

OPERATOR'S MANUAL

3-63

VOLT-AMP-WATTMETER
MODEL 390

SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois, ES 9-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

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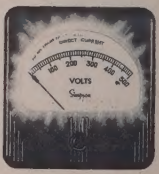

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OPERATOR'S MANUAL

VOLT-AMP-WATTMETER
DYNAMOMETER TYPE
MODEL 390

SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois, EStebrook 9-1121
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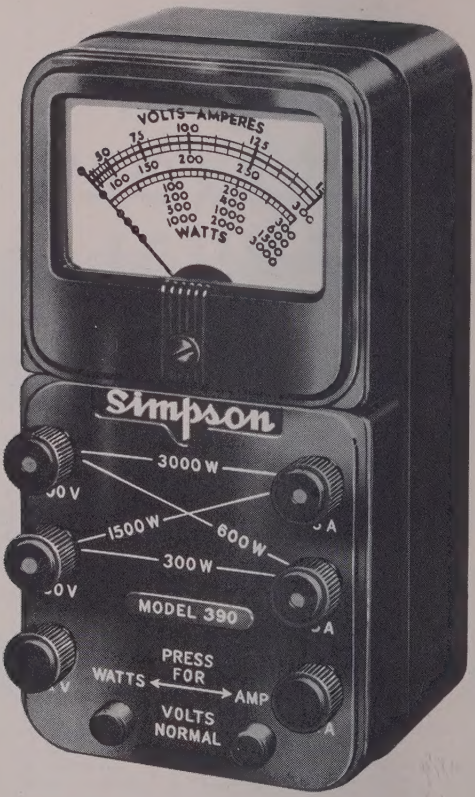


Figure 1 Simpson Model 390 Volt-Amp-Wattmeter

Size: 3" x 5⅞" x 2½". Weight: 2½ lbs.

TABLE OF CONTENTS

SECTION I GENERAL DESCRIPTION	PAR.	PAGE
General Introduction	1	9
Applications	2	10
Measurement Ranges	3	11
AC Voltage Measurements	4	11
DC Voltage Measurements	5	11
AC Current Measurements	6	12
AC Power Measurements	7	12
SECTION II OPERATING INSTRUCTIONS		
AC Voltage Measurements 0-150V, 0-300V	1	14
DC Voltage Measurements 0-150V, 0-300V	2	15
AC Current Measurements 0-3A, 0-15A	3	15
AC Power Measurements 0-300W, 0-1500W, (line voltage, 0-150)	4	16
AC Power Measurements 0-600W, 0-3000W, (line voltage, 150-300)	5	18
Use of Wattmeter without Break-in Plug	6	19
Use of Model 390 for Two or Three-phase Measurements	7	20
SECTION III FUNCTIONING OF PARTS		
AC and DC Voltmeter Circuit	1	21
AC Ammeter Circuit	2	21
AC Wattmeter Circuit	3	22
Schematic Diagram	4	23
Break-in Plug	5	24
SECTION IV MAINTENANCE		
Care	1	24
Replacement of Parts	2	26
Model 390 Parts List	3	26

LIST OF ILLUSTRATIONS

FIGURE No.	TITLE	PAGE
1.	Simpson Model 390 Volt-Amp-Wattmeter. . .	2
2.	Connections for Using Break-in Plug.	13
3.	Connections for Measurements in Single, Two and Three Phase AC Three-wire Circuits .	19
4.	Simplified Voltmeter Circuit	20
5.	Simplified Ammeter Circuit	21
6.	Simplified Wattmeter Circuit	22
7.	Model 390 Schematic Diagram	23
8.	Bottom View of Break-in Plug	24
9.	Model 390 Parts Layout--Rear View	25
10.	Model 390 and Break-in Plug in Use	27

Foreword

The Simpson Model 390 Volt-Amp-Wattmeter is the result of a determination to design an instrument that would give volt, ampere and watt readings all in one meter as compact as the famous Simpson line of Microtesters.

It is typical of the pioneering attitude of this company that this circuit analyzer should come from Simpson. It is the first instrument of its size capable of making the three simple tests that diagnose most cases of electrical appliance trouble: the tests for voltage, current drain and power consumption.

Like all other Simpson test equipment the Model 390 is made almost entirely within our various plants. Each part is carefully engineered and designed for its specific purpose and all components are assembled in such a manner that their original positions are permanently maintained. The full size 3" meter is of the dynamometer type, and is the smallest of its kind ever built into a test instrument. Simpson precision manufacture and Simpson quality standards have made the Model 390 capable of withstanding the strain of full load, continuous operation and the relatively severe handling to which an appliance tester is subjected.

Everything possible has been done to make the Model 390 easy to use and to give readings simply and quickly. The panel, as you see, has volt-ampere readings clearly indexed to the proper

sectors on the scale. All readings are shown on one meter; in normal position the meter indicates volts; ampere and watt readings are obtained merely by depressing buttons on the panel. An unusual feature is the uniform wattmeter scale whose equal graduations permit faster and more accurate readings. The separate binding posts make it possible for the Model 390 to be used as an individual voltmeter or as an ammeter.

The features that distinguish the Model 390 are the features that make all Simpson test equipment superior--the hidden virtues of quality materials and precision manufacture, the advanced engineering of internal design. Your pride in your new instrument will grow as you learn what these factors contribute to its accuracy and durability.

Your purchase of Simpson test equipment assures you of receiving equipment made almost entirely within the various plants of our Company. Each component part of the Model 390 has been completely designed, tooled and manufactured in our own plants, with the exception, of course, of a very few relatively unimportant parts. The Model 390, like all Simpson testers, is not assembled from purchased parts as is true of the majority of other testers on the market. Quality is controlled by Simpson at every step of production. We are a great deal more self-contained than any other manufacturer of test equipment. This is your assurance that the testers we offer will not quickly become obsolete. Our tremendous investment in expensive production tools is your safeguard against

obsolescence and your assurance of unvarying quality.

We do not consider our obligation completed when we have sold an instrument. Our interest in your Model 390 never ceases. We want your satisfaction with it to be continuous. That is the reason we provide this Operator's Manual. We want you to know how to secure all of the benefits from your 390.

The Model 390 has been constructed with utmost ruggedness and will withstand a great deal of abuse. But we urge you to remember that its mechanism is, of necessity, actually more delicate than that of a watch. Give it the care and careful handling it deserves and your Model 390 will give you a lifetime of accurate, dependable service.

OPERATOR'S MANUAL

SIMPSON MODEL 390 VOLT-AMP-WATTMETER

SECTION I

GENERAL DESCRIPTION

1. The Simpson Model 390 Volt-Amp-Wattmeter as shown in Figure 1 gives the electrical technician an AC voltmeter, DC voltmeter, AC ammeter and AC wattmeter all in one compact, convenient instrument. It is extremely rugged in construction yet of the highest quality, and will withstand full load, continuous operation. The full size 3" meter is of the dynamometer type with a moving coil armature operating within two field coils and has the typical Simpson workmanship and accuracy. The readings are clearly marked on two arcs of the scale, one for volts and amperes and one for watts. An unusual feature is the uniform wattmeter scale of equal divisions which permit more accurate readings.

A special break-in plug and lead assembly simplifies the connections necessary to secure all readings, under operating conditions. The terminals are arranged so that the instrument can be used with test leads when the break-in plug is not used. The designations for the wattmeter ranges are unique and make connections for the various ranges apparent at a glance. All markings are engraved on the panel and are filled with white enamel for maximum legibility.

The accuracy of the Model 390 is 5% or better of full scale reading. The errors due to phase angle

error and frequency are so small that they can be disregarded within the normal frequency range of 50 to 133 cycles. Approximately 2% should be added to the readings obtained at 25 cycle current. The loss in the Model 390 is very low and has no appreciable effect on the readings.

2. APPLICATIONS

The technician will find many uses for the Model 390 in checking line voltage, current drain and power consumption, the three simple tests which diagnose most cases of electrical trouble. For example, high current drain and high power consumption may indicate shorted turns in a motor, or too heavy a load or shorted portions in elements of heaters, irons, etc. This also might be indicated by an excessive drop in line voltage when the appliance is connected. A drop in line voltage may also indicate inadequate or overloaded supply lines. No current would indicate an open cord, switch or circuit in the appliance being checked. Among the many applications of the Model 390 are its uses in checking refrigerators, oil burners, washing machines, ventilating fans, air conditioning systems, air compressors, water pumps, vacuum cleaners, heaters, irons, toasters, waffle irons, food mixers, illuminating lamps, heat lamps, radios, television and any device on which a motor is used. In fact, any appliance which uses current within the limits of the instrument can be checked with the Model 390.

A typical example of the Model 390 in actual use is shown in Figure 10.

3. MEASUREMENT RANGES AVAILABLE

a. AC Volts
   0-150 volts
   0-300 volts

b. DC volts
   0-150 volts
   0-300 volts

c. AC amperes
   0-3 amperes
   0-15 amperes

d. AC watts

   0-300 watts, 0-1500 watts } 0-150 line voltage

   0-600 watts, 0-3000 watts } 150-300 line voltage

4. AC VOLTMETER MEASUREMENTS

AC voltage is measured by applying the voltage to the meter through suitable internal multiplying resistors. Both push buttons should be in the normal position.

5. DC VOLTAGE MEASUREMENTS

DC voltage measurements are made in the same

way as AC voltage measurements, the meter movement responding equally well in either case.

6. AC CURRENT MEASUREMENTS

AC amperes are measured by applying the current to the meter through an internal transformer having the proper turns ratio to give the correct reading. The push button marked "AMPS" should be pressed down. CAUTION: Failure to fully depress the button may result in a false reading.

7. AC POWER MEASUREMENTS

AC watts are measured by a circuit which permits the armature to be connected across the voltage source and the current transformer to be connected in series with the load. The push button marked "WATTS" should be pressed down. (Be sure to press button all the way down.)

SECTION II

OPERATING INSTRUCTIONS

ZERO ADJUSTMENT: Be sure that the pointer is on zero before taking any readings. If the pointer is off zero, adjust the setting by means of the slotted screw located in the bakelite case directly below the meter scale as shown in Figure 2. Use a small screwdriver to turn this adjustment slowly to the right or left until the pointer is directly over the zero point on the scale. Occasionally a static charge may accumulate on the meter glass and attract the pointer. This can be discharged by breathing on glass.

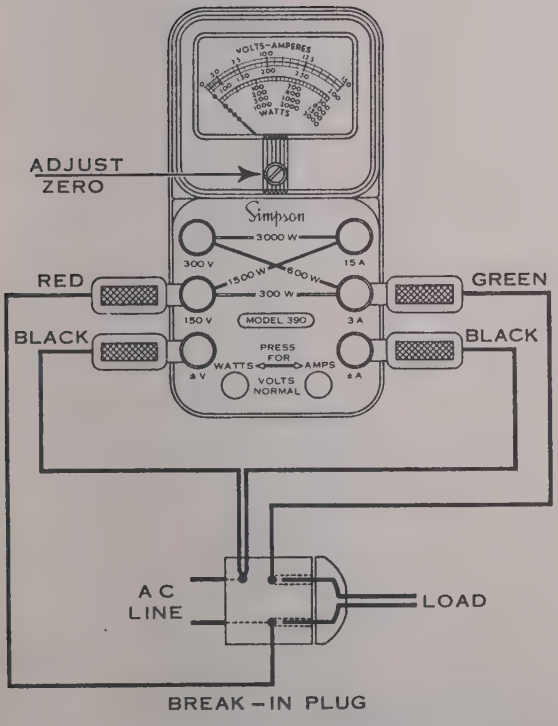


Figure 2. Model 390 Volt-Amp-Wattmeter--Method of Connecting Break-in Plug for 150V, 3A and 300W Ranges

1. AC VOLTAGE MEASUREMENTS 0-150V, 0-300V.

a. Connect the leads from the break-in plug according to color as shown in Figure 2. In order to use the 150V range connect the red lead to the terminal marked 150V as shown. The red lead should be connected to the terminal marked 300V, when the 300V range is to be used. For easy identification, the 150V and 300V terminals have a red dot in the centers and the 3A and 15A terminals have a green dot in the centers to correspond to the colors of the leads from the break-in plug.

b. Insert the break-in plug into the socket of the AC line to be measured.

c. Read the voltage on the top arc of the scale, using the figures 0-150 for the 150V range and 0-300 for the 300V range. When the appliance under test is plugged into the break-in plug, this will indicate the line voltage under various conditions, such as no load, full load, etc.

The first heavy line above zero represents 25 on the 0-150 range and 50 on the 0-300 range.

d. A pair of test leads may be used in place of the break-in plug. Connect one lead to the terminal marked $\pm$ V and the other lead to either the 150V or 300V terminal according to the range required. Connect the other ends across the circuit to be measured.

2. DC VOLTAGE MEASUREMENTS 0-150V, 0-300V.

The Model 390 can be used as a DC voltmeter except in cases where a high resistance meter is required. Follow the same procedure as for AC voltage measurements. Readings cannot be obtained on DC amperes or DC watts.

3. AC CURRENT MEASUREMENTS 0-3A, 0-15A.

a. Connect the leads from the break-in plug according to color as shown in Figure 2. In order to use the 3A range connect the green lead to the terminal marked "3A" as shown. When the 15A range is to be used, connect the green lead to the terminal marked "15A".

WHEN IN DOUBT OF THE CURRENT PRESENT, ALWAYS USE THE HIGHER RANGE FIRST AS A PROTECTION TO THE METER.

b. Insert the break-in plug into the socket of the AC line.

c. Plug the appliance to be checked into the break-in plug as shown in Figure 2.

d. Press the pushbutton marked "AMPS". CAUTION: Failure to fully depress the button may result in a false reading.

e. Read amperes on the top arc of the scale. For the 3A range, use the figures 0-300, with the black digits indicating the whole number and the red digits the decimal fraction. Use the figures 0-150 in the same way for the 15A range.

The first heavy line above zero represents 2.5 on the 15A range and .5 on the 3A range.

f. When the break-in plug is not adaptable the Model 390 can be used as an ammeter through the application of a pair of test leads. Connect them to the ± A and 3A terminals for the 3A range and to the ± A and 15A terminals for the 15A range. Open the circuit to be measured and connect the free ends of the test leads across the opening. Press the push button marked "AMPS" to read amperes. (Be sure to press button all the way down.)

It is sometimes desirable to check the load on an entire line. This can be done by removing a fuse from the fuse box and by connecting the Model 390 as an ammeter in series at this point or as a wattmeter as described in paragraph 6.

g. The current range of the Model 390 can be extended by the use of a current transformer. For example, a current transformer with a ratio of 10 to 1 when used with the 3 ampere range will permit current readings up to 30 amperes. The reading on the 3A range should be multiplied by 10. Current transformers with other ratios may be used in the same way, if the scale readings are multiplied by the ratio of the transformer.

4. AC. WATTS 0-300, 0-1500, USING BREAK-IN PLUG (line voltage 0-150).

a. Connect the leads from the break-in plug according to their color as shown in Figure 2. When the green lead is connected to the 3A terminal and the red lead is connected to the 150V terminal as

shown, the connecting line on the panel between the 150V and 3A terminals indicates that the 300 watt range is being used. When the green lead is connected to the 15A terminal, the range is 1500 watts as indicated by the line on the panel between the 150V and 15A terminals.

b. Insert the break-in plug into the socket of the AC line.

c. Plug the appliance to be checked into the break-in plug as shown in Figure 2.

d. Press the push button marked "WATTS". (Be sure to fully depress button.)

e. Read watts directly on the lower arc of the scale. Use the figures corresponding to the range being used. In an AC circuit containing only resistance, such as a toaster, the power will be approximately equal to the product of the volts and amperes. However, when the circuit contains reactance, such as a motor, the power will be less than the product of the volts and amperes because of the power factor.

The power factor of a circuit may be determined with the Model 390 in the following manner: Take the voltage, current and power readings of the circuit under test. Since unity power factor results when the power is equal to the product of the volts and amperes, the power factor of the circuit under test is the ratio of the power reading on the meter to the product of the volts and amperes. For example, if the line voltage is 120, current 2.5 amperes and power indicated by the meter is 225 watts,

the power factor is equal to $\frac{225}{120 \times 2.5}$ =75%.

f. In cases where the momentary load exceeds the limits of the 1500W range, such as the starting current of a motor, the red lead from the break-in plug may be connected to the 300V terminal and the 3000W range used.

CAUTION: This, of course, puts a load of more than 15 amperes on the current transformer and should be used only momentarily because any extended use may cause damage.

5. AC WATTS 0-600, 0-3000, USING BREAK-IN PLUG (line voltage 150-300).

a. Connect the red lead from the break-in plug to the 300V terminal. Connect the black leads to the ± V and ± A terminals as shown in Figure 2. When the green lead is connected to the 3A terminal, the line on the panel between the 300V and 3A terminals indicates that the 600 watt range is being used. When the green wire is connected to the 15A terminal, the range is 3000 watts as indicated by the line on the panel connecting the 300V and 15A terminals.

b. Insert the break-in plug into the socket of the AC line.

c. Plug the appliance to be checked into the break-in plug.

d. Press the push button marked "WATTS". (Be sure to press the button all the way down.)

e. Read watts directly on the lower arc of the scale. Use the figures corresponding to the range being used.

6. USE OF WATTMETER WITHOUT BREAK-IN PLUG.

In cases where it is not convenient to use the break-in plug for checking power, four wires or test leads can be used. For line voltages up to 150, connect the ± V and 150V terminals across the line and the ± A and 3A or 15A terminals in series with the load for the 300 and 1500 watt ranges respectively. A study of Figure 2 will make these connections clear.

For line voltages between 150-300, connect the ± V and 300V terminals across the line and the ± A and 3A or 15A terminals in series with the load for the 600 and 3000 watt ranges respectively.

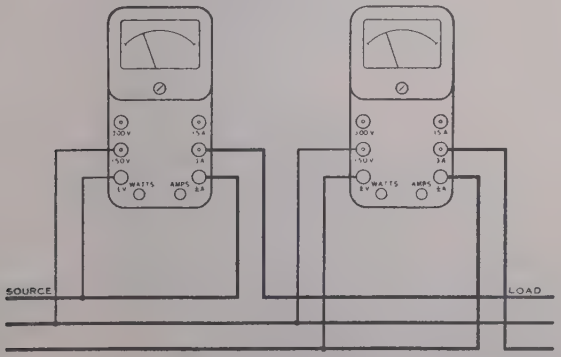


Figure 3. Connections for Measurements in Single, Two and Three Phase AC Three-Wire Circuits.

7. USE OF WATTMETER WITH TWO AND THREE PHASE CIRCUITS.

Figure 3 shows the connections for measuring power in single, two or three phase three-wire circuits using two Model 390 wattmeters. If a reading is obtained on both meters, the true power is the sum of the two readings. If the pointer of one meter deflects to the left of zero, it means that the power factor is less than 50% and the connection to the voltage terminals of that meter should be reversed. The reading then obtained should be subtracted from the reading of the other meter. If the power factor is exactly 50%, one meter will indicate zero. If only one Model 390 is available, connect it successively in the two positions as shown in Figure 3.

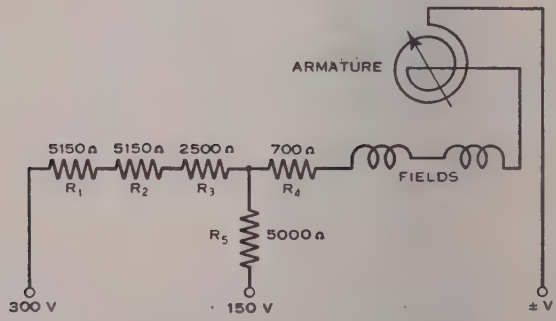


Figure 4. Simplified Voltmeter Circuit

SECTION III

FUNCTIONING OF PARTS

1. AC AND DC VOLTMETER CIRCUIT.

Figure 4 shows the circuit used when making voltage tests. The multiplier resistors for the 150V and 300V ranges are wound to match each meter and the approximate values are shown at R1, R2, R3, R4 and R5. The push buttons marked "WATTS" and "AMPS" are in normal position.

2. AC AMMETER CIRCUIT.

Figure 5 shows the ammeter circuit used when the push button marked "AMPS" is depressed. This connects the meter to transformer T1, the entire primary of which provides the 3 ampere range while the tap provides the 15 ampere range. Resistor R6 is for the purpose of calibration.

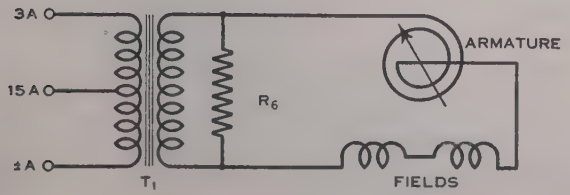


Figure 5. Simplified AC Ammeter Circuit

3. AC WATTMETER CIRCUIT.

Figure 6 shows the circuit used when the push button marked "WATTS" is depressed and the break-in plug connected for the 300 watt range. In this position the armature of the meter is connected across the line and the field coils of the meter are connected across the current transformer T1.

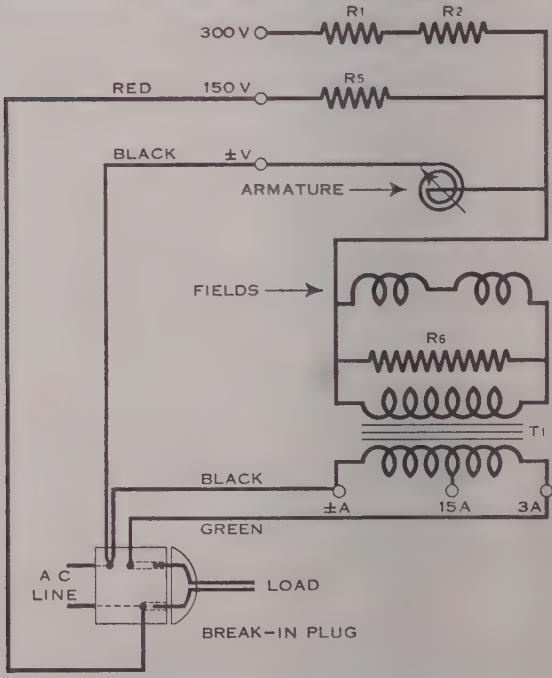


Figure 6. Simplified Wattmeter Circuit--300 Watt Range.

4. SCHEMATIC DIAGRAM.

The complete schematic diagram of the Model 390 combining the simplified circuits shown in Figures 4, 5 and 6 together with the "AMPS" and "WATTS" push buttons is shown in Figure 7.

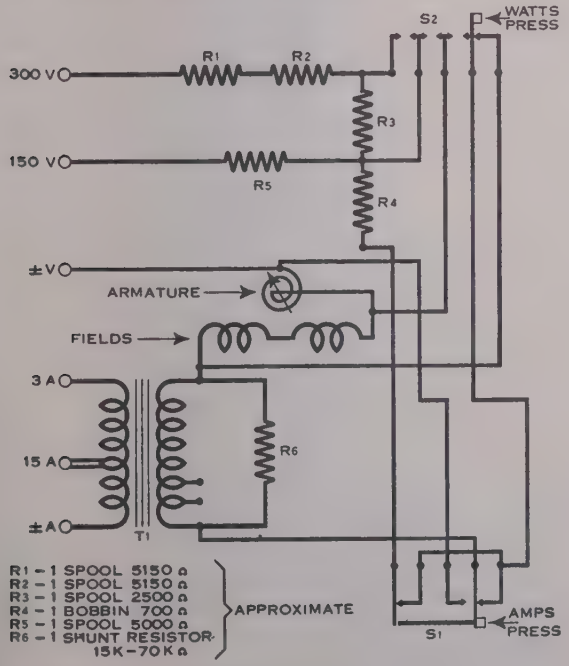


Figure 7. Model 390 Schematic Diagram

5. BREAK-IN PLUG.

The special break-in plug supplied permits connection across the line for voltage measurements and in series with the load for current measurements. These connections are clearly shown in Figures 2 and 6. Figure 8 shows the connections of the cable to the plug.

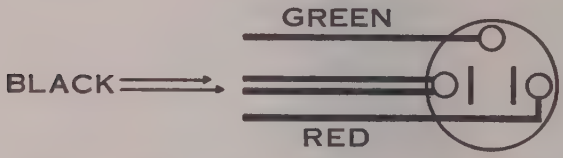


Figure 8. Bottom View of Break-in Plug, Showing Cable Connections.

SECTION IV

MAINTENANCE

1. CARE

The Model 390 is a rugged instrument and will withstand a great deal of abuse. We urge you, however, to treat it with care as its mechanism is actually more delicate than that of a watch. If you will keep it clean, free from continuous, severe vibration and avoid dropping it, your Model 390 will give you a lifetime of accurate, dependable service.

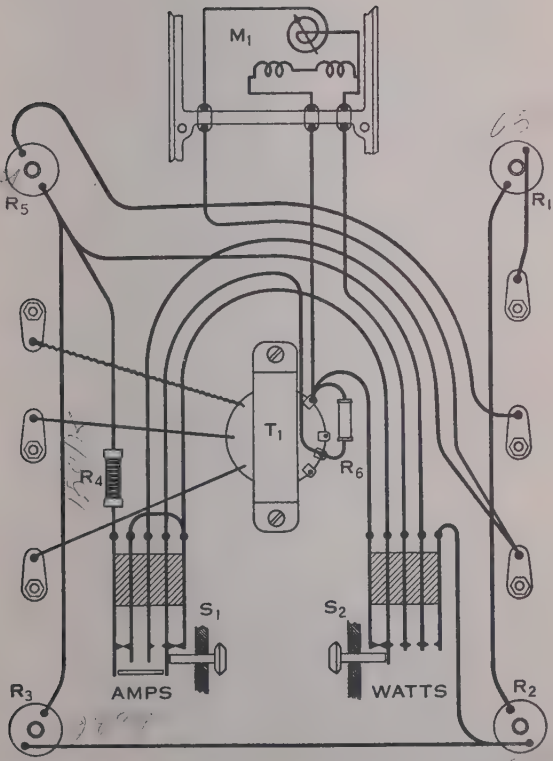


Figure 9. Model 390 Layout of Parts--Rear View

2. REPLACEMENT OF PARTS.

A parts layout diagram is shown in **Figure 9.** The diagram together with the following parts list, permits easy identification of parts in cases where replacements are necessary.

3. PARTS LIST.

PART No.	DESCRIPTION	REFERENCE SYMBOL
0-008945	Transformer	T1
0-008818	Switch assembly (AMPS)	S1
0-008817	Switch assembly (WATTS)	S2
24-302390	Model 390 Meter	M1
0-006848	Resistor--Spool approx. 2500 ohms	R3
0-006876	Resistor--Spool approx. 5000 ohms	R1, R2, R5
0-008301	Resistor--bobbin approx. 700 ohms	R4
0-005203	Bakelite base	
0-005509	Meter cover assembly	
3-320055	Lower cover	
3-310205	Binding post--red dot	
3-310206	Binding post--green dot	
3-310214	Push button	
1-113014	Series type plug only	
3-260076	Grip Left	
3-260075	Grip Right	Black - Spade Terminal Assembly
3-160015	Terminal	
1-113060	Rivet	
3-260077	Grip Left	
3-260078	Grip Right	Red - Spade Terminal Assembly
3-160015	Terminal	
1-113060	Rivet	
3-260079	Grip Left	
3-260080	Grip Right	Green - Space Terminal Assembly
3-160015	Terminal	
1-113060	Rivet	
0-008418	Break-in cord assembly (including plug and terminals)	

Note--Meter, resistors and transformer are calibrated together and are not interchangeable.

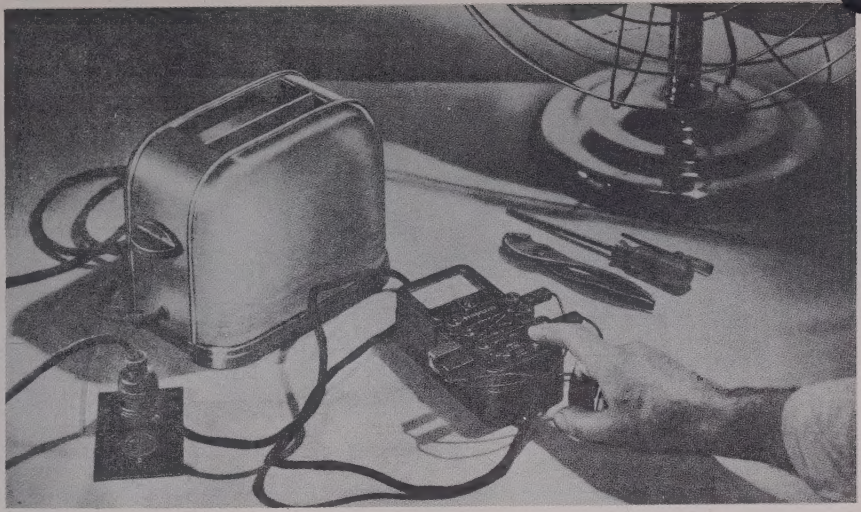
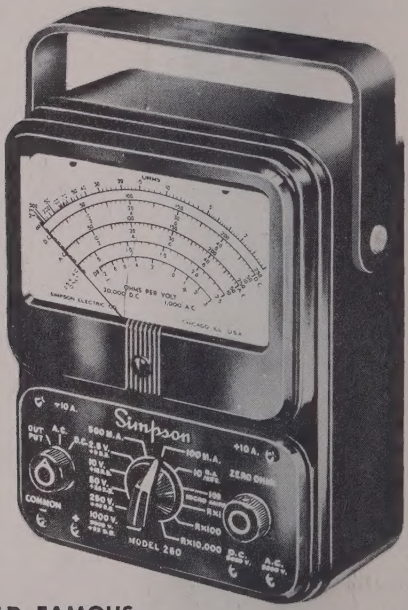


Figure 10 Simpson Model 390 Volt-Amp-Wattmeter in Use with Break-in Plug



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WARRANTY

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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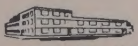
LAC DU FLAMBEAU PLANT

LAKE STREET PLANT


KINZIE STREET PLANT

AURORA PLANT

Quality is the indispensable component
of every Simpson instrument . . . . . .